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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/597,321	03/19/2007	Haluk Kulah	UOM0329PUSA	9295
22045	7590	09/15/2008		
BROOKS KUSHMAN P.C. 1000 TOWN CENTER TWENTY-SECOND FLOOR SOUTHFIELD, MI 48075			EXAMINER DOUGHERTY, THOMAS M	
			ART UNIT	PAPER NUMBER
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/597,321	Applicant(s) KULAH ET AL.	
	Examiner Thomas M. Dougherty	Art Unit 2834	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06/29/07.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 January 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>1006_607</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-8 and 10 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Carroll (US 5,814,921). Carroll shows (fig. 14) a method for generating electrical power from low frequency, vibrational energy (waves, see ABSTRACT), the method comprising: receiving vibrational energy having a low frequency (as noted, from waves); converting the low frequency, vibrational energy to vibrational energy having a high frequency greater than the low frequency; and converting the high frequency, vibrational energy to electrical power. Note in the ABSTRACT that the piezoelectric devices are electrical generators.

The step of converting the high frequency, vibrational energy is performed **piezoelectrically** or electrostatically or electromagnetically.

The low frequency is in the range of 1 to 100 Hz.

The step of converting the low frequency, vibrational energy is performed mechanically. See figure 1 where the teeth provide for frequency up conversion.

The step of receiving the low frequency, vibrational energy includes the step of providing a micromechanical first resonator device, the first resonator device resonating

in response to the received vibrational energy. This is clear from the discussion and figure 1.

As noted, the first resonator device has a mechanical resonance frequency in the range of 1 to 100 Hz.

The low frequency is in the range of 1 to 10Hz. Note that wave motion easily falls into this range, although it may be lower or higher.

The step of converting the low frequency, vibrational energy includes the step of providing a micromechanical second resonator device (10), the second resonator device (10) resonating at the high frequency in response to the resonating first resonator device (16).

The second resonator device (10) includes an array of micromechanical resonators.

Claims 1-3, 5-8 and 11 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Lee et al. article "NOVEL MICRO VIBRATION ENERGY HARVESTING DEVICE USING FREQUENCY UP CONVERSION". Lee et al. teach (page 871, INTRODUCTION) a method for generating electrical power from low frequency, vibrational energy, the method comprising: receiving vibrational energy having a low frequency; converting the low frequency, vibrational energy to vibrational energy having a high frequency greater than the low frequency; and converting the high frequency, vibrational energy to electrical power. See also figure 1.

The step of converting the high frequency, vibrational energy is performed **piezoelectrically** or electrostatically or electromagnetically. See the third paragraph of the INTRODUCTION.

The low frequency is in the range of 1 to 100 Hz. See the paragraph preceding the CONCLUSION at page 873.

The step of converting the low frequency, vibrational energy is performed mechanically. See figure 1 where the teeth provide for frequency up conversion.

The step of receiving the low frequency, vibrational energy includes the step of providing a micromechanical first resonator device, the first resonator device resonating in response to the received vibrational energy. This is clear from the discussion and figure 1.

As noted, the first resonator device has a mechanical resonance frequency in the range of 1 to 100 Hz.

The step of converting the low frequency, vibrational energy includes the step of providing a micromechanical second resonator device (in fig. 1, the component driven by the toothed component), the second resonator device resonating at the high frequency in response to the resonating first resonator device (in figure 1 the toothed device serves this capacity).

Lee et al. show (fig. 1) and discuss (INTRODUCTION) a micro power generator for generating electrical power from low frequency, vibrational energy, the generator comprising: means for receiving vibrational energy having a low frequency (toothed component) means for converting the low frequency, vibrational energy to vibrational

energy having a high frequency greater than the low frequency (to component driven by the teeth); and means for converting the high frequency, vibrational energy to electrical power. See discussion in sections 2 and 3 at page 872.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 4 is rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Lee et al. article "NOVEL MICRO VIBRATION ENERGY HARVESTING DEVICE USING FREQUENCY UP CONVERSION". Given the invention of Lee et al. as noted above, they do not specifically state that the low frequency is in the range of 1 to 10Hz.

It would have been obvious to one having ordinary skill in the art to allow the device to work in that frequency range since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Claims 4, 9 and 10 are rejected under 35 U.S.C. 103(a) as obvious over Lee et al. article "NOVEL MICRO VIBRATION ENERGY HARVESTING DEVICE USING FREQUENCY UP CONVERSION" further in view of Malkin et al. (US 2004/0075363).

Given the invention of Lee et al. as noted above, they do not specifically state that the low frequency is in the range of 1 to 10Hz.

Malkin et al. teach employment of an energy harvesting device that has a variety of structural members that resonate at different frequencies, thereby allowing recovery of energy at a variety of frequencies complementary of vibrations the structure. They also note that it is possible to generate power from a variety of frequencies by employing different sized resonant devices.

Malkin et al. show an array of resonators (16).

It would have been obvious to one having ordinary skill in the art to employ the teaching of Malkin et al. in the device of Lee et al. in order to harvest frequencies even in the elf range, including from 1Hz to 10Hz so that power can be generated, as is taught by Malkin et al. which such an arrayed structure may provide.

Claims 12-21 are rejected under 35 U.S.C. 103(a) as obvious over Lee et al. article "NOVEL MICRO VIBRATION ENERGY HARVESTING DEVICE USING FREQUENCY UP CONVERSION" further in view of Takeuchi (US 2002/0172060). Given the invention of Lee et al. as noted above they don't show a circuit coupled to the resonator devices for coupling the resonator devices together or an electromagnetic converter.

Takeuchi shows (fig. 4) a generator for generating electrical power from low frequency, vibrational energy, the generator comprising: a first resonator device which resonates in response to the vibrational energy (helical compression of springs, e.g. 72); a second resonator device (generating coil 52); and a circuit coupled to the

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resonator devices for coupling the resonator devices together so that the second resonator device resonates at a high frequency greater than the low frequency when the first resonator device resonates, the circuit also converting the high frequency, vibrational energy to electrical power. Note that when the spring is compressed at a low frequency rate, it will respond with a vibration of its own in response, at a higher frequency.

The high frequency, vibrational energy is converted electromagnetically.

The low frequency is in the range of 1 to 100 Hz. Note this depends on how the vehicle to which these devices are attached is operated.

The low frequency is in the range of 1 to 10 Hz, as noted above.

The conversion of the low frequency, vibrational energy is performed mechanically (through the springs).

The circuit includes a magnet (e.g. 64) and at least one coil (52) which moves relative to the magnet (64) and wherein voltage is induced on the at least one coil (52) by electromagnetic induction.

As noted, the first resonator device may have a mechanical resonance frequency in the range of 1 to 100 Hz depending on how it is driven.

As noted, at least one of the magnet and the at least one coil is mechanically coupled to the resonator devices so that the magnet and the at least one coil move relative to one another to generate voltage on the at least one coil.

Given that the energy harvesting devices are intended for use in vehicles, they are regarded as capable of operation in the range of 1 to 10 kHz.

The second resonator device includes an array of mechanical resonators and wherein each of the resonators has a coil formed thereon. Note that figure 4 shows an array of magnets and coils for generating power.

Takeuchi et al. don't specifically state that their invention is a micro-device.

It would have been obvious to one having ordinary skill in the art to employ the electromagnetic devices shown by Takeuchi in a micro-device such as is shown by Lee et al. since such would allow for more power generation given that there is room for more devices.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The remaining prior art cited reads on aspects of the claimed invention.

Direct inquiry to Examiner Dougherty at (571) 272-2022.

/T. M. D./

tmd

June 20, 2008

/Thomas M. Dougherty/

Primary Examiner, Art Unit 2834